

That which is claimed is:

1. An apparatus for attachment in an aperture of a fuel tank, the apparatus comprising:
  - a cap member having a catch, a vapor-inlet opening, a vapor-outlet opening, and a passageway interconnecting the vapor-inlet opening and the vapor-outlet opening;
  - a mounting portion defining a weldfoot and a clip, the weldfoot configured for welding to the fuel tank, the clip configured for engaging the catch to attach the cap member to the mounting portion; and
  - a valve housing attachable to the cap member, the valve housing at least partially disposed within an interior of the fuel tank, the valve housing configured for fuel-vapor communication with the interior of the fuel tank and the vapor-inlet opening of the cap member.
2. The apparatus as in Claim 1, wherein the catch depends inwardly from an inner surface of the cap member, the catch defining a contact surface configured to hold a complementary contact surface defined on the clip.
3. The apparatus as in Claim 1, wherein the cap member defines a retaining projection and the mounting portion defines a first opposing surface, the retaining projection and the first opposing surface cooperable to align the cap member and the mounting portion.
4. The apparatus as in Claim 3, wherein the retaining projection and the opposing surface circumferentially overlap.

5. The apparatus as in Claim 1, wherein the clip defines a second opposing surface and the housing defines a complementary retaining projection, the second opposing surface and the complementary retaining projection configured to cooperably align the cap member and the mounting portion.
6. The apparatus as in Claim 1, wherein the cap member defines an annular ring configured for mating to the valve housing.
7. The apparatus as in Claim 6, wherein the valve housing defines a complementary annular ring configured for mating with the annular ring of the cap member.
8. The apparatus as in Claim 6, wherein the cap member is made from a material selected from the group consisting of HDPE, nylon, POM, PEEK, and combinations thereof.
9. The apparatus as in Claim 1, wherein the mounting portion includes a laminate having multiple layers including a weldable layer, the laminate configured to block a permeation of fuel from about a surface of the fuel tank proximate the mounting portion, the laminate being disposed at least within the weldfoot and configured such that only the weldable layer is welded to the surface of the fuel tank.
10. The apparatus as in Claim 9, wherein the weldable layer is selected from the group consisting of a polymer, a metal, an adhesive, an anti-permeation material and combinations thereof.
11. The apparatus as in Claim 10, wherein the polymer is one of an HDPE, a conductive HDPE, a sulfonated HDPE and combinations thereof.

12. The apparatus as in Claim 10, wherein the anti-permeation material is one of EVOH, a sulfonated HDPE, and combinations thereof.
13. The apparatus as in Claim 1, further including a seal disposed between the housing and the weldfoot.
14. The apparatus as in Claim 13, wherein the housing defines a cavity and one of an o-ring, gasket, sealant or combinations thereof held between the cavity and mounting portion.
15. The apparatus as in Claim 1, wherein the housing includes a float therein and an opening therethrough in communication with the interior of the fuel tank and the vapor-inlet opening of the cap member, the float movable within the valve housing and configured to releasably seal the vapor-inlet opening of the cap member when a fuel from the fuel tank contacts the float and urges the float in a direction of the vapor-inlet opening of the cap member.
16. The apparatus as in Claim 1, wherein the clip is a plurality of clips and the catch is a plurality of catches, at least one of the clips snap-fittable on at least one of the catches.
17. The apparatus as in Claim 16, wherein a force of at least about 2000 Newtons is required to axially separate the cap member from the mounting portion.
18. The apparatus as in Claim 16, wherein the plurality of clips are spaced apart circumferentially from each other and radially apart from the valve housing.

19. The apparatus as in Claim 16, wherein the cap member further defines at least one aperture configured for inspecting a connection of the at least one catch and the at least one clip.

20. The apparatus as in Claim 19, wherein the at least one aperture is further configured for accessing the at least one clip to release the clip from the at least one catch such that the cap member is releasable from the mounting portion.

21. The apparatus as in Claim 1, wherein the clip depends from the weldfoot in a direction away from the surface of a fuel tank.

22. The apparatus as in Claim 21, wherein the clip is flexible relative to the weldfoot.

23. The apparatus as in Claim 1, wherein the catch defines an engaging surface positioned to face a complementary engaging surface of the clip, the engaging surface and the complimentary engaging surface configured to connectably oppose each other upon the clipping of the clip to the catch.

24. The apparatus as in Claim 23, wherein one of the engaging surface, the complementary engaging surface and combinations thereof are angled.

25. An apparatus for mounting a valve assembly in an aperture of a fuel tank, the apparatus comprising:

a cap member having a nozzle and one of a plurality of catches and a plurality of spaced apart clips, the nozzle defining a vapor-inlet opening, a vapor-outlet opening and a passageway therein;

a mounting portion defining a weldfoot and the other of the plurality of catches and the plurality of spaced-apart clips, the weldfoot configured for welding to a

surface of the fuel tank, the clips configured to clip a respective one of the catches, the clips further configured to flex relative to the weldfoot; and

a valve housing attachable to the cap member and at least partially disposed within an interior of the fuel tank, the valve housing configured for fuel-vapor communication with the interior of the fuel tank and the vapor-inlet opening of the cap member.

26. The apparatus as in Claim 25, wherein the plurality of catches depend inwardly from an inner surface of the cap member, the plurality of catches each defining a contact surface configured to hold a respective one of a plurality of complementary contact surfaces defined on the plurality of clips.

27. The apparatus as in Claim 25, wherein the cap member defines a retaining projection and the mounting portion defines an opposing surface, the retaining projection and the opposing surface cooperable to mate the cap member and the mounting portion together.

28. The apparatus as in Claim 25, wherein the cap member defines an annular ring configured for mating to the valve housing.

29. The apparatus as in Claim 28, wherein the valve housing defines a complementary annular ring configured for mating with the annular ring of the cap member.

30. The apparatus as in Claim 25, wherein the clips flex relative to the weldfoot upon axial insertion into the cap member.

31. The apparatus as in Claim 25, wherein the mounting portion includes a laminate having multiple layers including a weldable layer, the laminate configured to block a permeation of fuel from about the surface of the fuel tank and the mounting portion, the laminate being disposed at least within the weldfoot and configured such that only the weldable layer is welded to the surface of the fuel tank.
32. The apparatus as in Claim 25, wherein the valve housing defines a cavity configured to hold one of an o-ring, a gasket, a sealant, and combinations thereof.
33. The apparatus as in Claim 32, wherein the mounting portion is disposed adjacent the cavity such that one of the o-ring, the gasket, the sealant and combinations thereof are compressibly held therebetween.
34. The apparatus as in Claim 25, wherein each of the clips defines an opposing surface and the housing defines respective complementary retaining projections, each of the opposing surfaces and the complementary retaining projections configured to cooperably mate the top portion and the mounting portion together.
35. The apparatus as in Claim 25, wherein at least one of the clips is configured to snap-fit on at least one of the catches.
36. The apparatus as in Claim 35, wherein a force of at least about 2000 Newtons is required to axially separate the cap member from the mounting portion.
37. The apparatus as in Claim 35, wherein the cap member further defines at least one aperture configured for inspecting a connection of at least one catch connected to at least one clip.

38. The apparatus as in Claim 37, wherein the at least one aperture is further configured for accessing the at least one clip to release the clip from the at least one catch such that the cap member is releasable from the mounting portion.

39. A method for attaching a valve assembly to a fuel tank wall defining an aperture therethrough, the method comprising the steps of:

- a) providing a valve housing defining a first annular ring thereon;
- b) providing a cap member defining a second annular ring thereon and a plurality of catches, the annular rings complementary to each other;
- c) providing a mounting portion having a weldfoot and a plurality of clips depending from proximate the weldfoot;
- d) connecting the valve housing and the cap member together;
- e) mating respective catches and clips to connect the cap member and mounting portion together;
- f) inserting at least a portion of the valve housing through the aperture in the fuel tank wall such that the valve housing is in fuel-vapor communication with an interior of the fuel tank; and
- g) attaching the weldfoot to the fuel tank wall about the aperture.

40. The method as in Claim 39, wherein the mounting portion includes a laminate having multiple layers including a weldable layer, the laminate configured to block a permeation of fuel from about the aperture in the fuel tank well proximate the mounting portion, the laminate being disposed at least within the weldfoot.

41. The method as in Claim 40, further comprising the step of welding only the weldable layer is welded to the fuel tank wall.
42. The method as in Claim 40, wherein the weldable layer is selected from the group consisting of a polymer, a metal, an adhesive, an anti-permeation material and combinations thereof.
43. The method as in Claim 42, wherein the anti-permeation material is EVOH.
44. The method as in Claim 39, wherein the cap member further defines at least one aperture configured for inspecting a connection of at least one catch and at least one clip.
45. The method as in Claim 44, further comprising the step releasing the clip from the catch via the aperture to detach the cap member from the mounting portion.
46. The method as in Claim 39, further comprising the step of welding the annular rings together.
47. The method as in Claim 39, further comprising the step of inserting one of an o-ring, a gasket, a sealant, and combinations thereof between the mounting portion and the valve housing.
48. The method as in Claim 39, further comprising the steps of inserting a float in the valve housing and retaining the float in the valve housing.
49. An apparatus for mounting a valve assembly in an aperture of a fuel tank, the apparatus comprising:
- a cap member having a plurality of catches and a nozzle, the nozzle defining a vapor-inlet opening, a vapor-outlet opening and a passageway therein;



a mounting portion defining a weldfoot and a plurality of spaced-apart clips, the weldfoot having a multilayer laminate configured to reduce a fuel-vapor permeation from the fuel tank, the weldfoot configured for welding to a surface of the fuel tank, the clips configured to clip to a respective one of the catches, the clips further configured to flex relative to the weldfoot, respective portions of each of the clips interposed between each of the catches and the valve housing; and

a valve housing attachable to the cap member and at least partially disposed within an interior of the fuel tank, the valve housing configured for fuel-vapor communication with the interior of the fuel tank and the vapor-inlet opening of the cap member.

50. The apparatus as in Claim 49, wherein the plurality of catches depend inwardly from an inner surface of the cap member, the plurality of catches each defining a contact surface configured to hold a respective one of a plurality of complementary contact surfaces defined on the plurality of clips.

51. The apparatus as in Claim 49, wherein the cap member defines a retaining projection and the mounting portion defines an opposing surface, the retaining projection and the opposing surface cooperable to mate the cap member and the mounting portion together.

52. The apparatus as in Claim 49, wherein the cap member defines an annular ring configured for mating to the valve housing.

53. The apparatus as in Claim 52, wherein the valve housing defines a complementary annular ring configured for mating with the annular ring of the cap member.
54. The apparatus as in Claim 49, wherein the multilayer laminate has a weldable layer, the multilayer laminate being disposed at least within the weldfoot and configured such that only the weldable layer is welded to the surface of the fuel tank.
55. The apparatus as in Claim 49, wherein each of the clips defines an opposing surface and the housing defines respective complementary retaining projections, each of the opposing surfaces and the complementary retaining projections configured to cooperably mate the top portion and the mounting portion together.
56. An apparatus for attachment in an aperture of a fuel tank, the apparatus comprising:
- a cap member having a vapor-inlet opening, a vapor-outlet opening, and a passageway interconnecting the vapor-inlet opening and the vapor-outlet opening;
  - a mounting portion defining a weldfoot configured for welding to the fuel tank, wherein the mounting portion includes a laminate having multiple layers including a weldable layer, the laminate configured to block a permeation of fuel from about a surface of the fuel tank proximate the mounting portion, the laminate being disposed at least within the weldfoot and configured such that only the weldable layer is welded to the surface of the fuel tank;
  - means for connecting the cap member and the mounting portion together;
  - and

a valve housing attachable to the cap member, the valve housing at least partially disposed within an interior of the fuel tank, the valve housing configured for fuel-vapor communication with the interior of the fuel tank and the vapor-inlet opening of the cap member.

57. The apparatus as in Claim 56, wherein the means for connecting includes one of a clip, a catch, and combinations thereof defined on the cap member and one of the other of the clip, the catch, and combinations thereof defined on the mounting portion, the clip configured for engaging the catch to attach the cap member to the mounting portion.

58. The apparatus as in Claim 57, wherein the catch depends inwardly from an inner surface of the cap member, the catch defining a contact surface configured to hold a complementary contact surface defined on the clip.

59. The apparatus as in Claim 57, wherein the cap member defines a retaining projection and the mounting portion defines a first opposing surface, the retaining projection and the first opposing surface cooperable to align the cap member and the mounting portion.

60. The apparatus as in Claim 57, wherein the clip defines a second opposing surface and the housing defines a complementary retaining projection, the second opposing surface and the complementary retaining projection configured to cooperably align the cap member and the mounting portion.

61. The apparatus as in Claim 57, wherein the mounting portion includes a laminate having multiple layers including a weldable layer, the laminate configured to block a permeation of fuel from about a surface of the fuel tank proximate the mounting portion,

the laminate being disposed at least within the weldfoot and configured such that only the weldable layer is welded to the surface of the fuel tank.

62. An apparatus for mounting a valve assembly in an aperture of a fuel tank, the apparatus comprising;

a cap member having a first helical thread defined thereon and a nozzle, the nozzle defining a vapor-inlet opening, a vapor-outlet opening and a passageway therein;

a mounting portion defining a weldfoot and a second helical thread defined thereon, the weldfoot having a multilayer laminate configured to reduce a fuel-vapor permeation from the fuel tank, the weldfoot configured for welding to a surface of the fuel tank, the second helical thread configured for attachment with the first helical thread to attach the cap member and the mounting portion together; and

a valve housing attachable to the cap member and at least partially disposed within an interior of the fuel tank, the valve housing configured for fuel-vapor communication with the interior of the fuel tank and the vapor-inlet opening of the cap member.

63. The apparatus as in Claim 62, wherein the first helical thread defines an engaging surface disposed in a substantially vertical plane.

64. The apparatus as in Claim 62, wherein the cap member is made from a material selected from the group consisting of HDPE, nylon, POM, PEAK, and combinations thereof.

65. The apparatus as in Claim 62, wherein the multilayer laminate has a weldable layer, the multilayer laminate being disposed at least within the weldfoot and configured such that only the weldable layer is welded to the surface of the fuel tank.
66. The apparatus as in Claim 62, wherein the cap member defines a contact surface disposed apart from the surface of the fuel tank and the mounting portion has an opposing surface, the contact surface and the opposing surface configured to halt rotation of the first and second helical threads to attach the cap member and the mounting portion together.
67. The apparatus as in Claim 62, wherein the valve housing has a third helical thread defined thereon, the third helical thread further defining an engaging surface disposed in another substantially vertical plane substantially parallel to the vertical plane of the engaging surface of the first helical thread, the engaging surface of the third helical thread configured to abut an engaging surface of the second helical thread, the engaging surface of the second helical thread disposed substantially in a third vertical plane substantially parallel to the second vertical plane.
68. The apparatus as in Claim 62, further including one of an o-ring, a gasket, a sealant and combinations thereof disposed between one of the cap member, the mounting portion, the valve housing and combinations thereof.
69. An apparatus for mounting a valve assembly in an aperture of a fuel tank, the apparatus comprising:

a cap member having a holding piece, a vapor inlet opening, a vapor outlet opening, and a passageway interconnecting the vapor inlet opening and the vapor outlet opening;

a mounting portion defining a weldfoot and a projection to be held by the holding piece, the weldfoot configured for welding to the fuel tank, the holding piece and the projection piece cooperable to attach the cap member to the mounting portion; and

a valve housing attachable to the cap member, the valve housing at least partially disposed within an interior of the fuel tank, the valve housing configured for fuel vapor communication with the interior of the fuel tank and the vapor inlet opening of the cap member.

70. The apparatus as in Claim 69, wherein vertical cross sections of each of the valve housing, mounting portion, and cap member define a helical structure.

71. The apparatus as in Claim 69, wherein the projection piece is one of a clip, a helical thread, and combinations thereof.

72. The apparatus as in Claim 69, wherein the holding piece of the cap member is one of a catch, a complementary helical thread, and combinations thereof, the holding piece configured for removably capturing the projection piece of the mounting portion.

73. The apparatus as in Claim 69, wherein the mounting portion includes a laminate having multiple layers including a weldable layer, the laminate configured to block a permeation of fuel from about a surface of the fuel tank proximate the mounting portion, the laminate being disposed at least within the weldfoot and configured such that only the weldable layer is welded to the surface of the fuel tank.

74. A method for attaching a valve assembly to a fuel tank wall defining an aperture therethrough, the method comprising the steps of:

providing a valve housing defining a first helical thread thereon;

providing a cap member defining a second helical thread thereon, the first and the second helical threads complementary to each other to mate the cap member to the valve housing;

providing a mounting portion having a weldfoot and a third helical thread thereon depending from proximate the weldfoot;

rotatably attaching the cap member to the mounting portion via the second and third helical threads;

mating the valve housing to the attached cap member and mounting portion via the first and second helical threads;

inserting at least a portion of the valve housing through the aperture in the fuel tank wall such that the valve housing is in fuel vapor communication with an interior of the fuel tank; and

attaching the weldfoot to the fuel tank wall about the aperture.

75. The method as in Claim 74, further comprising the step of fixing the valve housing to the attached mounting portion and cap member by one of welding, heat staking, bonding, and combinations thereof.

76. The method as in Claim 75, wherein the step of fixing by bonding utilizes an adhesive.

77. The method as in Claim 74, further comprising the step of inserting an o-ring, an adhesive, a sealant, and combinations thereof between one of the valve housing, the cap member, the mounting portion and combinations thereof.